

ADHESIVE APPLICATION STATION FOR PRINTED PRODUCTSBACKGROUND OF THE INVENTION

The invention concerns an adhesive application station for binding stacked printed products by means of a liquid or liquefiable adhesive and a process for its operation, where said application station comprises an adhesive discharge system which substantially consists of an application head for the adhesive with a slip surface for the printed products and an application nozzle extending over the entire width of the slip surface with at least one outlet opening for the adhesive, an adhesive reservoir and means for generating a pressure for adhesive application.

For production of books, magazines, brochures etc. printed products of all types are first stacked and fixed in a holder. Then the so-called spine is milled flat and simultaneously roughened. In this way, the subsequently applied adhesive can adhere better. Insufficient adhesion of the adhesive leads to poor binding quality, the bound printed products fall apart in use or individual leaves become detached. The applied adhesive layer must however not only firmly bind each individual page but also be resilient to allow easy leaving through the bound printed products.

The application of adhesive with a brush or equivalent means as practiced originally was simplified as developments advanced so

that the prepared spine of a stack could be drawn over at least one roller immersed in an adhesive bath. This open system has however the disadvantage that, for example in the case of a moisture-reactive polyurethane adhesive, the physical and chemical properties could change under the effects of air and heat. The same or similar problems can occur in all known adhesives which are used as cold adhesives, hot adhesives or hot melts (thermoplastic adhesives). Advantageously, economical and ecological considerations have led for example to watery polyurethane dispersions, known in brief as PU dispersions. The term PU indicates a group of high molecular materials which are produced by poly-addition of di-isocyanates and bi- or multi-functional hydroxyl compounds. In their molecules the basic modules are linked by the urethane group ($-NH-COO-$). Depending on the chemical nature of the original compounds used, polyurethanes are obtained with linear, branched or cross-linked macromolecules. Linear polyurethanes are thermoplastic substances which have multiple applications. Here we are interested only in cross-linked elastomer polyurethanes which are suitable as resilient, water- and heat-resistant adhesives.

Adhesive application stations are known which work with slot nozzles. The prepared spine of a stack of printed products is drawn between two stops over a slip surface with an outlet slot

for the adhesive. The slot nozzle discharges adhesive during this short period.

Adhesives used in book binding are as has been stated often reactive, they react to relative air humidity. If there is no nozzle seal, the area between the metering device and the outlet opening of the nozzle is open, the nozzle is closed for example by hand with a metal plate. This system is, however, laborious and time-consuming. In addition, on starting and stopping of the adhesive application station the adhesive is not so well controlled.

A further known adhesive application station has a seal on the inside of the device. As a result control on starting and stopping of the adhesive application is adequate. However, between the seal and the nozzle outlet opening there is still an open adhesive system which has a tendency to clog and hence cause operating interruptions.

GB, A 447219 describes an adhesive device for book binding which simplifies the usual adhesive application with an application roller partly immersed in a liquid adhesive compound. A round tube with a slot, and which is closed at the end, is introduced tightly but rotatably in a sleeve which is also closed at the end, and which has outlet openings in the area of said slot. Arranged over the sleeve is a movable cover plate with a slip surface and passage openings over which cover plate the book

spines are drawn for gluing. By twisting or moving, the outlet openings can be at least partly overlaid and opened for the outflow of the adhesive pressed into the sleeve in the axial direction.

In all details US, A 2660148 shows a book binding machine with an adhesive extruder documenting the former state of the art. The paper stack prepared for binding is suspended between two clamping plates in the area of a roller-like, centrally controlled application device, where a distance is maintained from the central block. In the working cycle the extruder sprays adhesive onto the book spines by way of outlet openings. The adhesive-coated book spines are then passed over a measuring roller which corrects the layer thickness if necessary. Surplus adhesive is collected in a trough and returned to the adhesive reservoir, or recycled. The device as such is extremely complicated and, like GB, A 447219, can scarcely constitute a foundation for modern plants in view of its great age.

It is the principle object of the present invention to provide an adhesive application station for binding stacked printed products of the type described initially which eliminates the problems of clogged nozzle outlet openings.

SUMMARY OF THE INVENTION

The foregoing object is achieved wherein an adhesive discharge system comprises immediately adjacent to the outlet opening(s), a metering device which can be sealed manually and/or electronically controlled by an actuator and which, with the adhesive reservoir formed as a pressure chamber and an integral accumulator, forms a pressure compensation system, where in the accumulator are formed means acting directly on the adhesive reservoir arranged in or below the application head, whereby after each adhesive discharge an automatic pressure compensation is guaranteed.

In the direction of running of the printed products, on both sides of the slip surface is arranged a stop for these still separate sheets. The outlet opening(s) for the adhesive must be covered so well at the sides that no adhesive strings can occur on the bound stack of printed products.

An application nozzle is formed in co-operation between the adhesive outlet opening(s) and the metering device arranged immediately below this. The metering device in turn limits the adhesive reservoir formed as a pressure compensation system which is arranged in or below the application head and directly connected with an adhesive dispenser, in particular a pressure vessel. This has the advantage not previously achieved that all the adhesive from the reservoir, preferably formed as a pressure

vessel, to the outlet opening(s) in the application head never comes into contact with air, which prevents the chemical and physical changes mentioned above. The use of a pressure vessel in particular has the further advantage that only the quantity required is melted. Totally fresh adhesive is always available.

To generate the necessary pressure in the adhesive reservoir, a directly acting plunger of a pressure cylinder is provided in a pneumatic accumulator. The necessary pressure can, however, also be generated hydraulically, electromagnetically with a linear motor, mechanically with a spindle, or in other known ways.

The pressure can be, and is, modified in relation to the machine speed so that all parameters are optimally matched.

The metering device and the inside of the outlet opening(s) to the slip surface form a preferably tight-fit seal. This can be completely closed and thus prevent not only the passage of adhesive but also the penetration of air into the compensation system, which - as has been shown above - is of essential importance.

In the working position the outlet opening(s) of the slip surface and those of the metering device are matched to each other so that the adhesive can flow out unhindered. In a special embodiment the outlet cross-section of the outlet opening(s) in the slip surface is adjusted in steps or continuously so the outlet opening(s) is(are) partly still covered by the metering

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The depth of the outlet opening(s) of the slip surface - depending on the mechanical stability of the adhesive application system - lies in the order of maximum a few millimeters, preferably 0.1 - 5 mm, in particular 0.5 - 2 mm.

Also, the metering device in the application head can merely be longitudinally displaceable. In this case a central longitudinal channel and bores running transverse to the longitudinal direction can be provided, cut out longitudinally at a distance apart greater than their diameter. In this case a corresponding number of outlet openings must be cut out in the slip surface. The longitudinal bores of the metering device and those of the slip surface must be able to be brought into complete alignment. By displacing the metering device longitudinally, the adhesive supply can be closed air-tight, partly or fully opened.

As a stack always contains the same number of printed products which are cut from the same print carrier web, the width of the slip surface with the adhesive outlet slot can be set precisely. In practice however deviations occur in stack height which leads to undesirable adhesive strings. From experience, however, the tolerance ranges are very narrow. Even in large stacks they are normally maximum approximately ± 0.5 mm, in exceptional cases maximum ± 1 mm.

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achieved in the form of chamfers but also by suitably curved surfaces.

The stop which is resilient in the slot direction - below, for the sake of simplicity, reference is made only to the slot solution for adhesive outlet which is by far the most common in practice - with a guide surface can be structured according to various variants irrespective of whether a resilient stop and a fixed stop are formed or whether both stops are resilient:

According to a first variant, a guided carriage, resilient as a whole, can be moved on a nozzle block of the application head in the direction of the outlet slot and with its guide surface form a resilient stop.

In a further variant a suitably cylindrical roller which is movable in the slot direction in a positionable holder, and with an axis perpendicular to the slip surface, can be the guide surface.

In a still further variant a slide guided in the slot direction is formed with a correspondingly shaped front guide surface. The slide is movable in the direction of the guide slot, for example against the resistance of a spring or against a pneumatic pressure, and arranged in a precisely positionable retainer.

According to a last variant mentioned here, a leaf spring is arranged at the front on a positionable holder already mentioned,

As already indicated, the movable stop is automatically returnable preferably by spring force. In the same way the movable stop can be pneumatically sprung. As the necessary tolerance range as has been stated is very narrow, and usually only amounts to fractions of a millimeter, the movable stop must be positionable precisely.

Furthermore, the movable stop lying on the adhesive outlet slot must cover this so well that no adhesive strings form on the bound stack of printed products. As the stops with the side guide surfaces, except for the variant with a leaf spring, can be formed more or less solid, this is in principle no problem. A short insert or thickening in a plate spring can also fulfill this purpose.

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All stops with the guide surfaces for the stack of printed products to be bound preferably consist of wear-resistant polished material as the print media drawn over these, in particular paper, acts as an abrasive cloth. Special steels, hard metals, ceramic materials or cermets are suitable materials for guide surfaces.

The lack of contact with the air in particular prevents operating interruptions due to clogging.

The invention is explained in more detail using the exemplary embodiments shown in the drawing, which are the subject of dependent claims. These show diagrammatically:

Fig. 2 is a principle sketch of a pressure system with pressure compensation in cross-section,

Fig. 4 is a front view of Fig. 3,

Fig. 5 is a side view of Fig. 3 (from the left),

Fig. 6 is an application head in top view,

Fig. 7 is a side view of Fig. 6 (from the right),

Fig. 8 is a metering device formed as a metering shaft with slot,

Fig. 9 is a metering device with a longitudinally movable metering body,

Fig. 10 is a cross-section through a metering device according to Fig. 9,

Fig. 11 is a part longitudinal section XI - XI according to Fig. 10 in the working position, and

Fig. 12 is a part longitudinal section according to Fig. 11 in the rest position.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT(S)

Fig. 1 shows a preferred design example of the binding of stacked printed products 10 on an application head 12 of an adhesive application station 14 (Figs. 3 to 5). A slip surface 16 of a nozzle block 18 of the application head 12 has an outlet slot 20 running in the longitudinal direction for an adhesive 52 (Fig. 2), forming an application edge. In the present case the slot width s of the outlet slot 20 is approximately 0.2 mm. This slot width is not normally modifiable but, however, in practice can be adjusted by precise turning of the metering shaft (44 in Fig. 2).

The slip surface 16 is bordered at the side by a fixed stop 22 with a first guide surface 24, including a deflector 24a, and a retainer 26 with a second guide surface 28, including a deflector 28a, for a printed product 10. The retainer 26 can be moved and positioned precisely in the direction of the double arrow 30 which runs parallel to the outlet slot 20. In the present case the retainer 26 guides a slide 32 which can be pressed into the retainer 26 against a spring force within a close tolerance range t in the direction of the double arrow 34 also running parallel to the outlet slot 20. The slide 32 has a third guide surface 36 for stacked printed products 10 also with a deflector 36a. Both this third guide surface 36 and the first guide surface 24 are angled and expand as deflectors 24a, 36a against the introduction device E for stacked printed products 10. The close tolerance range t for the slide 32 which can be returned by spring force is limited by a bore 38 in the retainer 26 and a bolt 40 projecting into this bore from the slide 32.

To bind stacked printed products, first the retainer 26 with slide 32 is positioned corresponding to the minimum thickness d of the stacked printed products 10, and for example adjusted with a screw. For a tolerance range of for example 0.5 mm for the thickness d of the stacked printed products, the width g of the slip surface 16 is set at distance $d + t$, assuming that the slide 32 is pressed flush against the second guide surface 28 at maximum

tolerance t . The slide 32 is pressed in when the stacked printed products 10 are introduced, when they are pushed along deflectors 24a, 36a of the first and third guide surfaces 24, 26. When reaching the outlet slot 20 the adhesive application begins mechanically, electronically or sensor-controlled and ends when the printed product 10 leaves the area of the outlet slot 20.

Both the retainer 26 and the slide 32 seal the outlet slot 20 when and where they lie on the sliding surface 16.

When the stacked printed products 10 are guided over the outlet slot 20, they are pressed by the slide 32 onto the first side guide surface 24. The second guide surface 28 does not in this case act as such, the stacked printed products 10 slide along the third guide surface 36 with deflector 36a. On binding according to Fig. 1, differences with regard to thickness d of the stacked printed products 10 both within the same stack and from stack to stack, are compensated automatically, adhesive cannot be discharged next to the printed products 10, thus avoiding not only a loss of adhesive but also the formation of undesirable adhesive strings.

According to a variant not shown, the slide 32 can be omitted and the retainer 26 itself formed as a movable stop resilient in the tolerance range. In this case the stacked printed products 10 slide along the second guide surface 28 with deflector.

20 immediately switches into the working position shown in dotted lines, the slot 46 of the metering shaft 44 in this position connects the adhesive reservoir 50 with the outlet slot 20. Immediately after the stacked printed products 10 have left the area of the outlet slot 20, the sensor-controlled electronics initiate the rotation of the metering shaft 44 into the rest position, the adhesive supply to the outlet slot 20 is interrupted.

The pressure loss occurring in the adhesive reservoir 50 by the output of adhesive is compensated automatically as the plunger 58 is pushed correspondingly deeper into the adhesive reservoir 50. The pressure in the adhesive reservoir 50 is determined by the cross-sectional ratio of the pressure cylinder 56 to the plunger 58 and the pressure in a preliminary chamber 64 of the accumulator 54. The pressure in this preliminary chamber is for example in the range from 0.7 to 0.8 bar.

Evidently, the binding process for the stacked printed products 10 can be manual or semi-automatic.

A basic design principle of an adhesive application station 14 as a whole is shown in Figs. 3 to 5. The functional division into application head 12, adhesive reservoir 50 (pressure chamber) and accumulator 54 is evident. Essential individual elements of the application head 12 are shown individually in Figs. 6 to 12.

thread and can therefore be connected directly with a larger interchangeable adhesive reservoir, for example a barrel pump. This guarantees absolute air-tight seal of the adhesive. The prevention of contact of the adhesive with air, which is the aim of the invention, is achieved.

The accumulator 54 is connected with the adhesive reservoir 50 via four spacer pipes 84. Fig. 4 shows a bore 86 for compressed air which comprises the usual connection fittings not shown. The pressure medium is guided into a preliminary chamber (64 in Fig. 2) and acts on a pressure cylinder 56 shown in dotted lines which amplifies the pressure surface-proportional and transfers this by way of a plunger 58 to the adhesive reservoir 50.

Fig. 6 shows an application head 12 of an adhesive application station 14 with automatic compensation for the stack thickness of printed products 10 in top view, corresponding substantially - although side-inverted - to Fig. 3. For the sake of clarity in particular the fixing bolts for the fixed stop 22 and the retainer 26 are omitted, only the bores 88, 90 for bolts are shown in the slots 66, 68.

The nozzle block 18 according to Fig. 6 in the longitudinal direction not only has the outlet slot 20 for the adhesive but also linear guide elements. The slip surface 16 is angled slightly downwards along an edge 92 and thus forms an angled

The width g of the slip surface 16 is set practically to the maximum possible value. It could be enlarged slightly by moving the fixed stop 22. The minimum width g of the slip surface 16 is limited by the length of the slots 66 and in particular 68.

The side view of Fig. 6 (from the right) shown in Fig. 7 shows hatched the end of the nozzle block 18. Below the guide block 72 with the knurled nut 76 can be seen part of the adjustment plate 70 and, at the bottom, part of the retainer 26.

Also, in the nozzle block 18 is held a heating cartridge 102 and a temperature sensor 104 which serve to set the correct adhesive temperature in the application head 12. In a recess 106 can be laid electrical cables, distributors or similar electrical components.

A metering shaft 44 shown in Fig. 8 is equipped at one end with a shaft lock 122 and at the other end is mounted a swivel lever 80 for manual or mechanical application of torque. A socket-head bolt 126 which is secured with its tip in a tapered recess of the shaft 44 prevents idle rotation of the lever 80.

In the left-hand area of the metering shaft is cut a linear groove which corresponds in function to a slot 46 (Fig. 2). A radial groove 124 is also provided which ensures the supply of adhesive when the metering shaft is in the working position. The metering shaft 44 can be swivelled into the rest position in the direction of double arrow 128.

Fig. 9 shows a variant of a metering shaft 44. Instead of a slot 46 (Fig. 8) radial bores 47 are formed which are connected by a central channel, not shown. This is supplied by way of a radial groove 124 (Fig. 8) also not shown. In the present case the radial bores 47 are formed circular in cross-section. These can, however, also assume another geometric shape, in particular that of slots. The end of the metering shaft 44 pointing away from the radial bores 47 is held in an actuator 130. This can for example be formed as a stepper motor and swivel the metering shaft 44 in the direction of the double arrow 128 through a previously determined angle and thus adjust from the working position to the rest position and vice versa. The actuator 130 can also be

activated by a control unit 132 so that the cross-section of the radial bores 47 is not fully exposed.

Figs. 10 to 12 show the working method of a longitudinally displaceable metering body 45. This is substantially of rectangular cross-section and as such cannot be swivelled. The outlet opening 20 of width s of 0.1 mm is divided into four part sections, interrupted in each case by a web 136 of the working head 12.

In Fig. 11, the working position, the adhesive 52 can be brought from the adhesive reservoir 50 by way of channels 134 in the longitudinally displaceable metering body 45 into the outlet openings 20.

In the view in Fig. 12 the metering body 45 is moved by distance d in the longitudinal direction L . The channels 134 in the metering body 45 now lie in the area of the webs 136 of the application head 12. Thus, in this variant also the adhesive discharge system 15 (Fig. 2) is sealed immediately adjacent to the outlet openings 20, which is the aim of the invention.

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